



ENGINEERING,  
INC.

ENGINEERS  
SURVEYORS

# STORMWATER REPORT

For

## “Definitive Subdivision”

24 Oak Street-Map 39 Lot M-20  
Wareham, MA

Prepared for

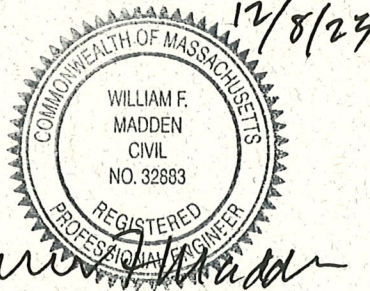
**David M. Mather**

24 Oak Street  
Wareham, MA 02571

Prepared by

**G.A.F. Engineering, Inc.**

266 Main Street  
Wareham, MA 02571



**December 4, 2023**

G.A.F. Job No.: 18-9257

266 MAIN ST.  
WAREHAM, MA 02571

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## Table of Contents

- Drainage Narrative.....
- Runoff Calculations.....
- 72 Hour Drawdown Analysis.....
- Soil Map.....
- Watershed Map.....

## DRAINAGE NARRATIVE

### General Description

This project is a two lot Definitive Subdivision of Land located at 24 Oak Street in Wareham, Mass. There is one existing home on the property in close proximity to Oak Street. A sixteen foot wide road approximately two hundred forty feet in length is proposed to be constructed to provide access and legal frontage for one new single family home. This project is therefore exempt from the requirements of the Massachusetts Stormwater Management Standards since the development results in four or fewer single family units. The goal of the drainage system design is to mitigate any potential increase in runoff to Oak Street.

### Drainage System Design

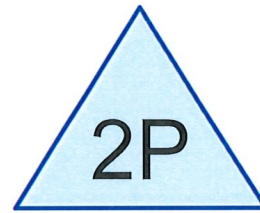
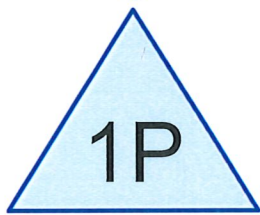
The topography of the site is such that runoff is directed toward Oak Street. Grading for the new road is proposed with a low point about twenty feet in from the existing edge of pavement. The new road will be crowned and crushed stone filled trenches will be installed along the edge of travelled way on both sides. Two deep sump hooded catch basins will be installed at the low point of the road, one on each side. The catch basins will discharge to a row of 8 leaching galleys with two feet of stone around them and one foot beneath.

Soils at the site as mapped by the USDA Natural Resources Conservation Service consist of Poquonock sand (323B), 8-15 percent slopes, very stony, for the upper portion of the property and Gloucester-Canton complex (453C), 8-15 percent slopes, extremely bouldery, adjacent to Oak Street. Both soil types are indicated to be highly pervious and are classified with a Hydrologic Soil Group (HSG) rating A. A test pit was excavated in the area of proposed infiltration. Soils were found to consist of loamy sand. The infiltration rates used for the crushed stone trenches and leaching galleys was input at 2.41 inches per hour based on the Rawls rate for HSG A soils comprised of loamy sand.

The drainage calculations indicate that the combination of the leaching trenches and galleys have sufficient capacity to mitigate the flows from all storms up to and including the 100 year storm event. We therefore conclude that the construction of the system consistent with the design plans will provide adequate mitigation of potential increases in runoff to Oak Street.

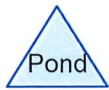


ROADWAY



STONE TRENCH

GALLEYS



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Page 2

**Rainfall Events Listing**

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2 Year Storm	Type III 24-hr		Default	24.00	1	3.44	2
2	10 Year Storm	Type III 24-hr		Default	24.00	1	5.05	2
3	25 Year Storm	Type III 24-hr		Default	24.00	1	6.05	2
4	100 Year Storm	Type III 24-hr		Default	24.00	1	7.59	2

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Page 3

**Area Listing (all nodes)**

Area (acres)	CN	Description (subcatchment-numbers)
0.173	39	>75% Grass cover, Good, HSG A (1S)
0.015	98	Crushed Stone Trench (1S)
0.003	98	Half Metal Building (1S)
0.093	98	Paved Road, HSG A (1S)
0.071	30	Woods, Good, HSG A (1S)
<b>0.356</b>	<b>56</b>	<b>TOTAL AREA</b>

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Page 4

**Soil Listing (all nodes)**

Area (acres)	Soil Group	Subcatchment Numbers
0.337	HSG A	1S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.019	Other	1S
<b>0.356</b>		<b>TOTAL AREA</b>

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Page 5

**Ground Covers (all nodes)**

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.173	0.000	0.000	0.000	0.000	0.173	>75% Grass cover, Good	1S
0.000	0.000	0.000	0.000	0.015	0.015	Crushed Stone Trench	1S
0.000	0.000	0.000	0.000	0.003	0.003	Half Metal Building	1S
0.093	0.000	0.000	0.000	0.000	0.093	Paved Road	1S
0.071	0.000	0.000	0.000	0.000	0.071	Woods, Good	1S
<b>0.337</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.019</b>	<b>0.356</b>	<b>TOTAL AREA</b>	



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Page 6

**Pipe Listing (all nodes)**

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	1P	25.90	25.90	5.0	0.0000	0.010	0.0	8.0	0.0	

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Quentin Way - 24 Oak Street, Wareham  
Type III 24-hr 2 Year Storm Rainfall=3.44"

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Page 7

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: ROADWAY**

Runoff Area=15,505 sf 31.31% Impervious Runoff Depth=0.36"  
Flow Length=260' Tc=16.6 min CN=56 Runoff=0.06 cfs 0.011 af

**Pond 1P: STONE TRENCH**

Peak Elev=25.50' Storage=26 cf Inflow=0.06 cfs 0.011 af  
Discarded=0.04 cfs 0.011 af Primary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.011 af

**Pond 2P: GALLEYS**

Peak Elev=21.75' Storage=0 cf Inflow=0.00 cfs 0.000 af  
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

**Total Runoff Area = 0.356 ac Runoff Volume = 0.011 af Average Runoff Depth = 0.36"**  
**68.69% Pervious = 0.245 ac 31.31% Impervious = 0.111 ac**

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Quentin Way - 24 Oak Street, Wareham  
 Type III 24-hr 2 Year Storm Rainfall=3.44"

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Page 8

**Summary for Subcatchment 1S: ROADWAY**

Runoff = 0.06 cfs @ 12.43 hrs, Volume= 0.011 af, Depth= 0.36"  
 Routed to Pond 1P : STONE TRENCH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 2 Year Storm Rainfall=3.44"

Area (sf)	CN	Description
* 4,042	98	Paved Road, HSG A
* 150	98	Half Metal Building
* 662	98	Crushed Stone Trench
7,541	39	>75% Grass cover, Good, HSG A
3,110	30	Woods, Good, HSG A
15,505	56	Weighted Average
10,651		68.69% Pervious Area
4,854		31.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.7	50	0.0100	0.05		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.44"
0.9	210	0.0640	4.07		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
16.6	260	Total			

**Summary for Pond 1P: STONE TRENCH**

Inflow Area = 0.356 ac, 31.31% Impervious, Inflow Depth = 0.36" for 2 Year Storm event  
 Inflow = 0.06 cfs @ 12.43 hrs, Volume= 0.011 af  
 Outflow = 0.04 cfs @ 12.66 hrs, Volume= 0.011 af, Atten= 29%, Lag= 14.0 min  
 Discarded = 0.04 cfs @ 12.66 hrs, Volume= 0.011 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af  
 Routed to Pond 2P : GALLEYS

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2  
 Peak Elev= 25.50' @ 12.66 hrs Surf.Area= 648 sf Storage= 26 cf

Plug-Flow detention time= 4.5 min calculated for 0.011 af (100% of inflow)  
 Center-of-Mass det. time= 4.5 min ( 948.7 - 944.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	25.40'	676 cf	<b>1.50'W x 432.00'L x 3.00'H Prismatic</b> 1,944 cf Overall - 255 cf Embedded = 1,689 cf x 40.0% Voids
#2	25.90'	151 cf	<b>8.0" Round Pipe Storage</b> Inside #1 L= 432.0' 255 cf Overall - 1.2" Wall Thickness = 151 cf
		826 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	25.40'	<b>2.410 in/hr Exfiltration over Wetted area</b>
#2	Primary	25.90'	<b>8.0" Round Culvert</b> L= 5.0' Ke= 0.500 Inlet / Outlet Invert= 25.90' / 25.90' S= 0.0000 '/ Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf

**Discarded OutFlow** Max=0.04 cfs @ 12.66 hrs HW=25.50' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.04 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=25.40' (Free Discharge)  
 ↑2=Culvert ( Controls 0.00 cfs)

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Quentin Way - 24 Oak Street, Wareham  
 Type III 24-hr 2 Year Storm Rainfall=3.44"

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Page 10

**Summary for Pond 2P: GALLEYS**

Inflow Area = 0.356 ac, 31.31% Impervious, Inflow Depth = 0.00" for 2 Year Storm event  
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af  
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min  
 Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af  
 Routed to nonexistent node 3P

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2  
 Peak Elev= 21.75' @ 0.00 hrs Surf.Area= 288 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)  
 Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	21.75'	445 cf	<b>8.00'W x 36.00'L x 5.50'H Excavation/Stone</b> 1,584 cf Overall - 471 cf Embedded = 1,113 cf x 40.0% Voids
#2	22.75'	355 cf	<b>Concrete Galley 4x4x4 x 8 Inside #1</b> Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf
#3	25.90'	38 cf	<b>4.00'D x 1.50'H Vertical Cone/Cylinder x 2 -Impervious</b>
#4	27.40'	6 cf	<b>2.00'D x 1.00'H Vertical Cone/Cylinder x 2</b>
#5	28.40'	165 cf	<b>Custom Stage Data (Prismatic) Listed below (Recalc) -Impervious</b>
		1,009 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
28.40	50	0	0
29.00	500	165	165

Device	Routing	Invert	Outlet Devices
#1	Discarded	21.75'	<b>2.410 in/hr Exfiltration over Wetted area</b>
#2	Primary	28.40'	<b>2.0" x 2.0" Horiz. Orifice/Grate X 72.00</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	28.80'	<b>5.0' long x 5.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

**Discarded OutFlow** Max=0.00 cfs @ 0.00 hrs HW=21.75' (Free Discharge)  
 ↑ **1=Exfiltration** (Passes 0.00 cfs of 0.02 cfs potential flow)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=21.75' (Free Discharge)  
 ↑ **2=Orifice/Grate** ( Controls 0.00 cfs)  
 ↓ **3=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

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Type III 24-hr 10 Year Storm Rainfall=5.05"

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Page 11

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: ROADWAY**

Runoff Area=15,505 sf 31.31% Impervious Runoff Depth=1.07"  
Flow Length=260' Tc=16.6 min CN=56 Runoff=0.27 cfs 0.032 af

**Pond 1P: STONE TRENCH**

Peak Elev=26.15' Storage=206 cf Inflow=0.27 cfs 0.032 af  
Discarded=0.07 cfs 0.027 af Primary=0.12 cfs 0.005 af Outflow=0.19 cfs 0.032 af

**Pond 2P: GALLEYS**

Peak Elev=22.88' Storage=136 cf Inflow=0.12 cfs 0.005 af  
Discarded=0.02 cfs 0.005 af Primary=0.00 cfs 0.000 af Outflow=0.02 cfs 0.005 af

**Total Runoff Area = 0.356 ac Runoff Volume = 0.032 af Average Runoff Depth = 1.07"**  
**68.69% Pervious = 0.245 ac 31.31% Impervious = 0.111 ac**

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Page 12

**Summary for Subcatchment 1S: ROADWAY**

Runoff = 0.27 cfs @ 12.27 hrs, Volume= 0.032 af, Depth= 1.07"  
 Routed to Pond 1P : STONE TRENCH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10 Year Storm Rainfall=5.05"

Area (sf)	CN	Description
* 4,042	98	Paved Road, HSG A
* 150	98	Half Metal Building
* 662	98	Crushed Stone Trench
7,541	39	>75% Grass cover, Good, HSG A
3,110	30	Woods, Good, HSG A
15,505	56	Weighted Average
10,651		68.69% Pervious Area
4,854		31.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.7	50	0.0100	0.05		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.44"
0.9	210	0.0640	4.07		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
16.6	260	Total			

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Page 13

**Summary for Pond 1P: STONE TRENCH**

Inflow Area = 0.356 ac, 31.31% Impervious, Inflow Depth = 1.07" for 10 Year Storm event  
 Inflow = 0.27 cfs @ 12.27 hrs, Volume= 0.032 af  
 Outflow = 0.19 cfs @ 12.52 hrs, Volume= 0.032 af, Atten= 29%, Lag= 14.9 min  
 Discarded = 0.07 cfs @ 12.52 hrs, Volume= 0.027 af  
 Primary = 0.12 cfs @ 12.52 hrs, Volume= 0.005 af  
 Routed to Pond 2P : GALLEYS

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2  
 Peak Elev= 26.15' @ 12.52 hrs Surf.Area= 648 sf Storage= 206 cf

Plug-Flow detention time= 17.6 min calculated for 0.032 af (100% of inflow)  
 Center-of-Mass det. time= 17.6 min ( 915.4 - 897.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	25.40'	676 cf	<b>1.50'W x 432.00'L x 3.00'H Prismatic</b> 1,944 cf Overall - 255 cf Embedded = 1,689 cf x 40.0% Voids
#2	25.90'	151 cf	<b>8.0" Round Pipe Storage</b> Inside #1 L= 432.0' 255 cf Overall - 1.2" Wall Thickness = 151 cf
		826 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	25.40'	<b>2.410 in/hr Exfiltration over Wetted area</b>
#2	Primary	25.90'	<b>8.0" Round Culvert</b> L= 5.0' Ke= 0.500 Inlet / Outlet Invert= 25.90' / 25.90' S= 0.0000 '/ Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf

**Discarded OutFlow** Max=0.07 cfs @ 12.52 hrs HW=26.15' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.07 cfs)

**Primary OutFlow** Max=0.12 cfs @ 12.52 hrs HW=26.15' (Free Discharge)  
 ↑2=Culvert (Barrel Controls 0.12 cfs @ 1.48 fps)



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Quentin Way - 24 Oak Street, Wareham  
 Type III 24-hr 10 Year Storm Rainfall=5.05"

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Page 14

**Summary for Pond 2P: GALLEYS**

Inflow Area = 0.356 ac, 31.31% Impervious, Inflow Depth = 0.15" for 10 Year Storm event  
 Inflow = 0.12 cfs @ 12.52 hrs, Volume= 0.005 af  
 Outflow = 0.02 cfs @ 13.03 hrs, Volume= 0.005 af, Atten= 81%, Lag= 30.7 min  
 Discarded = 0.02 cfs @ 13.03 hrs, Volume= 0.005 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af  
 Routed to nonexistent node 3P

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2  
 Peak Elev= 22.88' @ 13.03 hrs Surf.Area= 288 sf Storage= 136 cf

Plug-Flow detention time= 65.0 min calculated for 0.005 af (100% of inflow)  
 Center-of-Mass det. time= 65.0 min ( 823.9 - 758.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	21.75'	445 cf	<b>8.00'W x 36.00'L x 5.50'H Excavation/Stone</b> 1,584 cf Overall - 471 cf Embedded = 1,113 cf x 40.0% Voids
#2	22.75'	355 cf	<b>Concrete Galley 4x4x4 x 8 Inside #1</b> Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf
#3	25.90'	38 cf	<b>4.00'D x 1.50'H Vertical Cone/Cylinder x 2 -Impervious</b>
#4	27.40'	6 cf	<b>2.00'D x 1.00'H Vertical Cone/Cylinder x 2</b>
#5	28.40'	165 cf	<b>Custom Stage Data (Prismatic) Listed below (Recalc) -Impervious</b>
		1,009 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
28.40	50	0	0
29.00	500	165	165

Device	Routing	Invert	Outlet Devices
#1	Discarded	21.75'	<b>2.410 in/hr Exfiltration over Wetted area</b>
#2	Primary	28.40'	<b>2.0" x 2.0" Horiz. Orifice/Grate X 72.00 C= 0.600</b> Limited to weir flow at low heads
#3	Primary	28.80'	<b>5.0' long x 5.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

**Discarded OutFlow** Max=0.02 cfs @ 13.03 hrs HW=22.88' (Free Discharge)  
 ↑ **1=Exfiltration** (Exfiltration Controls 0.02 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=21.75' (Free Discharge)  
 ↑ **2=Orifice/Grate** ( Controls 0.00 cfs)  
 ↓ **3=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

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Type III 24-hr 25 Year Storm Rainfall=6.05"

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Page 15

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: ROADWAY**

Runoff Area=15,505 sf 31.31% Impervious Runoff Depth=1.63"  
Flow Length=260' Tc=16.6 min CN=56 Runoff=0.44 cfs 0.048 af

**Pond 1P: STONE TRENCH**

Peak Elev=26.29' Storage=264 cf Inflow=0.44 cfs 0.048 af  
Discarded=0.08 cfs 0.035 af Primary=0.29 cfs 0.013 af Outflow=0.37 cfs 0.048 af

**Pond 2P: GALLEYS**

Peak Elev=24.69' Storage=440 cf Inflow=0.29 cfs 0.013 af  
Discarded=0.03 cfs 0.013 af Primary=0.00 cfs 0.000 af Outflow=0.03 cfs 0.013 af

**Total Runoff Area = 0.356 ac Runoff Volume = 0.048 af Average Runoff Depth = 1.63"**  
**68.69% Pervious = 0.245 ac 31.31% Impervious = 0.111 ac**

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Page 16

**Summary for Subcatchment 1S: ROADWAY**

Runoff = 0.44 cfs @ 12.26 hrs, Volume= 0.048 af, Depth= 1.63"  
 Routed to Pond 1P : STONE TRENCH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25 Year Storm Rainfall=6.05"

	Area (sf)	CN	Description
*	4,042	98	Paved Road, HSG A
*	150	98	Half Metal Building
*	662	98	Crushed Stone Trench
	7,541	39	>75% Grass cover, Good, HSG A
	3,110	30	Woods, Good, HSG A
	15,505	56	Weighted Average
	10,651		68.69% Pervious Area
	4,854		31.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.7	50	0.0100	0.05		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.44"
0.9	210	0.0640	4.07		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
16.6	260	Total			

**Summary for Pond 1P: STONE TRENCH**

Inflow Area = 0.356 ac, 31.31% Impervious, Inflow Depth = 1.63" for 25 Year Storm event  
 Inflow = 0.44 cfs @ 12.26 hrs, Volume= 0.048 af  
 Outflow = 0.37 cfs @ 12.39 hrs, Volume= 0.048 af, Atten= 17%, Lag= 8.3 min  
 Discarded = 0.08 cfs @ 12.39 hrs, Volume= 0.035 af  
 Primary = 0.29 cfs @ 12.39 hrs, Volume= 0.013 af  
 Routed to Pond 2P : GALLEYS

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2  
 Peak Elev= 26.29' @ 12.39 hrs Surf.Area= 648 sf Storage= 264 cf

Plug-Flow detention time= 17.7 min calculated for 0.048 af (100% of inflow)  
 Center-of-Mass det. time= 17.7 min ( 901.0 - 883.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	25.40'	676 cf	<b>1.50'W x 432.00'L x 3.00'H Prismaoid</b> 1,944 cf Overall - 255 cf Embedded = 1,689 cf x 40.0% Voids
#2	25.90'	151 cf	<b>8.0" Round Pipe Storage</b> Inside #1 L= 432.0' 255 cf Overall - 1.2" Wall Thickness = 151 cf
		826 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	25.40'	<b>2.410 in/hr Exfiltration over Wetted area</b>
#2	Primary	25.90'	<b>8.0" Round Culvert</b> L= 5.0' Ke= 0.500 Inlet / Outlet Invert= 25.90' / 25.90' S= 0.0000 '/ Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf

**Discarded OutFlow** Max=0.08 cfs @ 12.39 hrs HW=26.29' (Free Discharge)  
 ↕ **1=Exfiltration** (Exfiltration Controls 0.08 cfs)

**Primary OutFlow** Max=0.29 cfs @ 12.39 hrs HW=26.29' (Free Discharge)  
 ↕ **2=Culvert** (Barrel Controls 0.29 cfs @ 1.94 fps)

**9257\_REV 2**

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Page 18

**Summary for Pond 2P: GALLEYS**

Inflow Area = 0.356 ac, 31.31% Impervious, Inflow Depth = 0.45" for 25 Year Storm event  
 Inflow = 0.29 cfs @ 12.39 hrs, Volume= 0.013 af  
 Outflow = 0.03 cfs @ 13.21 hrs, Volume= 0.013 af, Atten= 89%, Lag= 49.2 min  
 Discarded = 0.03 cfs @ 13.21 hrs, Volume= 0.013 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af  
 Routed to nonexistent node 3P

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2  
 Peak Elev= 24.69' @ 13.21 hrs Surf.Area= 288 sf Storage= 440 cf

Plug-Flow detention time= 157.2 min calculated for 0.013 af (100% of inflow)  
 Center-of-Mass det. time= 157.2 min ( 915.0 - 757.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	21.75'	445 cf	<b>8.00'W x 36.00'L x 5.50'H Excavation/Stone</b> 1,584 cf Overall - 471 cf Embedded = 1,113 cf x 40.0% Voids
#2	22.75'	355 cf	<b>Concrete Galley 4x4x4 x 8 Inside #1</b> Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf
#3	25.90'	38 cf	<b>4.00'D x 1.50'H Vertical Cone/Cylinder x 2 -Impervious</b>
#4	27.40'	6 cf	<b>2.00'D x 1.00'H Vertical Cone/Cylinder x 2</b>
#5	28.40'	165 cf	<b>Custom Stage Data (Prismatic) Listed below (Recalc) -Impervious</b>
		1,009 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
28.40	50	0	0
29.00	500	165	165

Device	Routing	Invert	Outlet Devices
#1	Discarded	21.75'	<b>2.410 in/hr Exfiltration over Wetted area</b>
#2	Primary	28.40'	<b>2.0" x 2.0" Horiz. Orifice/Grate X 72.00</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	28.80'	<b>5.0' long x 5.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

**Discarded OutFlow** Max=0.03 cfs @ 13.21 hrs HW=24.69' (Free Discharge)  
 ↑**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=21.75' (Free Discharge)  
 ↑**2=Orifice/Grate** ( Controls 0.00 cfs)  
 ↓**3=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

**9257\_REV 2**

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Quentin Way - 24 Oak Street, Wareham  
Type III 24-hr 100 Year Storm Rainfall=7.59"

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Page 19

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: ROADWAY**

Runoff Area=15,505 sf 31.31% Impervious Runoff Depth=2.61"  
Flow Length=260' Tc=16.6 min CN=56 Runoff=0.75 cfs 0.077 af

**Pond 1P: STONE TRENCH**

Peak Elev=26.50' Storage=340 cf Inflow=0.75 cfs 0.077 af  
Discarded=0.09 cfs 0.046 af Primary=0.61 cfs 0.032 af Outflow=0.70 cfs 0.077 af

**Pond 2P: GALLEYS**

Peak Elev=28.41' Storage=844 cf Inflow=0.61 cfs 0.032 af  
Discarded=0.04 cfs 0.027 af Primary=0.21 cfs 0.005 af Outflow=0.26 cfs 0.032 af

**Total Runoff Area = 0.356 ac Runoff Volume = 0.077 af Average Runoff Depth = 2.61"**  
**68.69% Pervious = 0.245 ac 31.31% Impervious = 0.111 ac**

**9257\_REV 2**

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Quentin Way - 24 Oak Street, Wareham  
 Type III 24-hr 100 Year Storm Rainfall=7.59"

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Page 20

**Summary for Subcatchment 1S: ROADWAY**

Runoff = 0.75 cfs @ 12.24 hrs, Volume= 0.077 af, Depth= 2.61"  
 Routed to Pond 1P : STONE TRENCH

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 100 Year Storm Rainfall=7.59"

	Area (sf)	CN	Description
*	4,042	98	Paved Road, HSG A
*	150	98	Half Metal Building
*	662	98	Crushed Stone Trench
	7,541	39	>75% Grass cover, Good, HSG A
	3,110	30	Woods, Good, HSG A
	15,505	56	Weighted Average
	10,651		68.69% Pervious Area
	4,854		31.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.7	50	0.0100	0.05		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.44"
0.9	210	0.0640	4.07		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
16.6	260	Total			

**Summary for Pond 1P: STONE TRENCH**

Inflow Area = 0.356 ac, 31.31% Impervious, Inflow Depth = 2.61" for 100 Year Storm event  
 Inflow = 0.75 cfs @ 12.24 hrs, Volume= 0.077 af  
 Outflow = 0.70 cfs @ 12.32 hrs, Volume= 0.077 af, Atten= 7%, Lag= 4.4 min  
 Discarded = 0.09 cfs @ 12.32 hrs, Volume= 0.046 af  
 Primary = 0.61 cfs @ 12.32 hrs, Volume= 0.032 af  
 Routed to Pond 2P : GALLEYS

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2  
 Peak Elev= 26.50' @ 12.32 hrs Surf.Area= 648 sf Storage= 340 cf

Plug-Flow detention time= 16.5 min calculated for 0.077 af (100% of inflow)  
 Center-of-Mass det. time= 16.5 min ( 884.8 - 868.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	25.40'	676 cf	<b>1.50'W x 432.00'L x 3.00'H Prismatic</b> 1,944 cf Overall - 255 cf Embedded = 1,689 cf x 40.0% Voids
#2	25.90'	151 cf	<b>8.0" Round Pipe Storage</b> Inside #1 L= 432.0' 255 cf Overall - 1.2" Wall Thickness = 151 cf
		826 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	25.40'	<b>2.410 in/hr Exfiltration over Wetted area</b>
#2	Primary	25.90'	<b>8.0" Round Culvert</b> L= 5.0' Ke= 0.500 Inlet / Outlet Invert= 25.90' / 25.90' S= 0.0000 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf

**Discarded OutFlow** Max=0.09 cfs @ 12.32 hrs HW=26.50' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.09 cfs)

**Primary OutFlow** Max=0.61 cfs @ 12.32 hrs HW=26.50' (Free Discharge)  
 ↑2=Culvert (Barrel Controls 0.61 cfs @ 2.43 fps)



**Summary for Pond 2P: GALLEYS**

[81] Warning: Exceeded Pond 1P by 2.35' @ 13.56 hrs

Inflow Area = 0.356 ac, 31.31% Impervious, Inflow Depth = 1.07" for 100 Year Storm event  
 Inflow = 0.61 cfs @ 12.32 hrs, Volume= 0.032 af  
 Outflow = 0.26 cfs @ 12.70 hrs, Volume= 0.032 af, Atten= 58%, Lag= 22.9 min  
 Discarded = 0.04 cfs @ 12.68 hrs, Volume= 0.027 af  
 Primary = 0.21 cfs @ 12.70 hrs, Volume= 0.005 af  
 Routed to nonexistent node 3P

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2  
 Peak Elev= 28.41' @ 12.70 hrs Surf.Area= 294 sf Storage= 844 cf

Plug-Flow detention time= 204.6 min calculated for 0.032 af (100% of inflow)  
 Center-of-Mass det. time= 203.9 min ( 966.2 - 762.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	21.75'	445 cf	<b>8.00'W x 36.00'L x 5.50'H Excavation/Stone</b> 1,584 cf Overall - 471 cf Embedded = 1,113 cf x 40.0% Voids
#2	22.75'	355 cf	<b>Concrete Galley 4x4x4 x 8 Inside #1</b> Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf
#3	25.90'	38 cf	<b>4.00'D x 1.50'H Vertical Cone/Cylinder x 2 -Impervious</b>
#4	27.40'	6 cf	<b>2.00'D x 1.00'H Vertical Cone/Cylinder x 2</b>
#5	28.40'	165 cf	<b>Custom Stage Data (Prismatic) Listed below (Recalc) -Impervious</b>
		1,009 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
28.40	50	0	0
29.00	500	165	165

Device	Routing	Invert	Outlet Devices
#1	Discarded	21.75'	<b>2.410 in/hr Exfiltration over Wetted area</b>
#2	Primary	28.40'	<b>2.0" x 2.0" Horiz. Orifice/Grate X 72.00 C= 0.600</b> Limited to weir flow at low heads
#3	Primary	28.80'	<b>5.0' long x 5.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

**Discarded OutFlow** Max=0.04 cfs @ 12.68 hrs HW=28.41' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.04 cfs)

**Primary OutFlow** Max=0.15 cfs @ 12.70 hrs HW=28.41' (Free Discharge)  
 ↑2=Orifice/Grate (Weir Controls 0.15 cfs @ 0.32 fps)  
 ↓3=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

## 72 Hour Drawdown Analysis

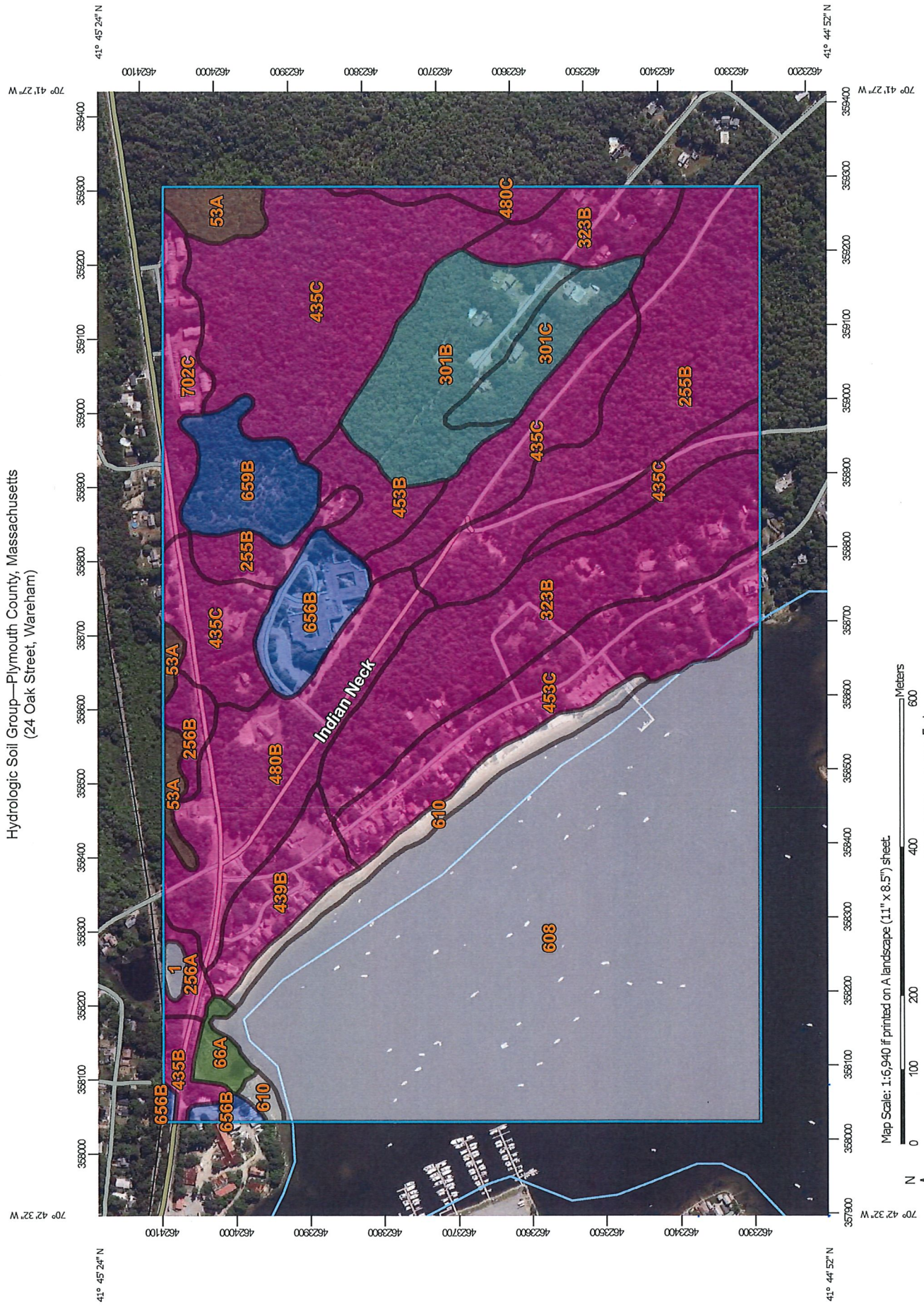
Leaching Galley System Drawdown time (72 hrs. max. for the 100 year storm volume)

$$\text{Time} = \frac{\text{Storage Volume}}{(\text{Rawls Rate}) (\text{Bottom Area})}$$

$$\text{Time} = \frac{844 \text{ cf}}{(2.41 \text{ inches/hour})(1 \text{ ft}/12 \text{ inches})(288 \text{ sf})}$$

14.6 hours < 72 hours - OK

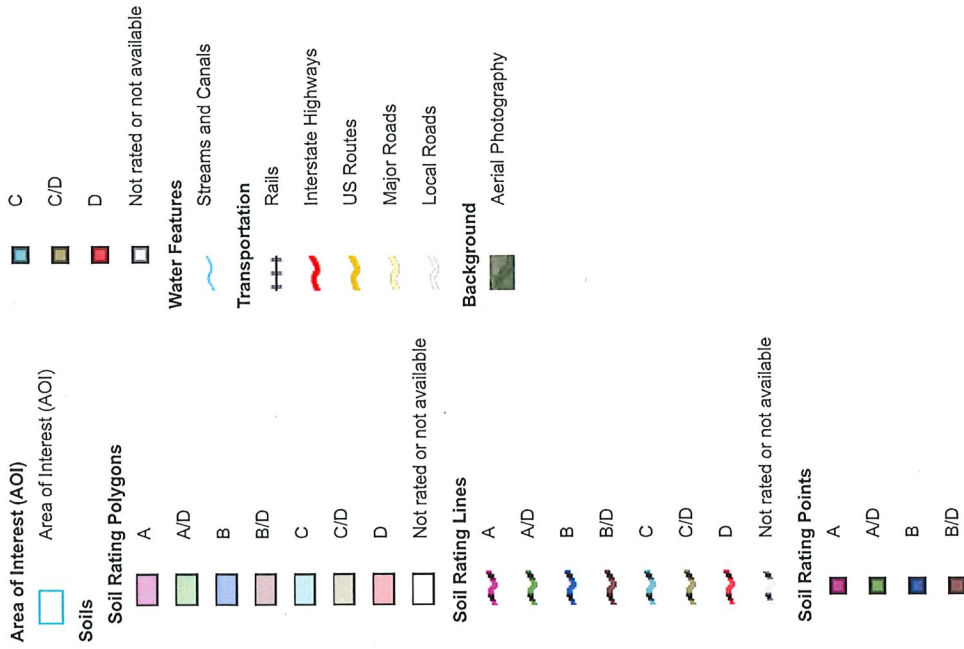
Hydrologic Soil Group—Plymouth County, Massachusetts  
(24 Oak Street, Wareham)



Map Scale: 1:6,940 if printed on A landscape (11" x 8.5") sheet



## MAP LEGEND



## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL:  
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Plymouth County, Massachusetts  
 Survey Area Data: Version 16, Sep 10, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 10, 2022—Jun 30, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		0.5	0.2%
53A	Freetown muck, ponded, 0 to 1 percent slopes	B/D	3.7	1.5%
66A	Ipswich - Pawcatuck - Matunuck complex, 0 to 2 percent slopes, very frequently flooded	A/D	1.4	0.6%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	23.4	9.3%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	A	1.1	0.4%
256B	Deerfield loamy fine sand, 3 to 8 percent slopes	A	1.6	0.6%
301B	Montauk fine sandy loam, 0 to 8 percent slopes, very stony	C	12.2	4.8%
301C	Montauk fine sandy loam, 8 to 15 percent slopes, very stony	C	4.8	1.9%
323B	Poquonock sand, 3 to 8 percent slopes, very stony	A	25.0	9.9%
435B	Plymouth loamy coarse sand, 3 to 8 percent slopes	A	1.6	0.6%
435C	Plymouth loamy coarse sand, 8 to 15 percent slopes	A	38.4	15.2%
439B	Gloucester - Canton complex, 3 to 8 percent slopes	A	5.2	2.1%
453B	Gloucester - Canton complex, 3 to 8 percent slopes, extremely bouldery	A	3.6	1.4%
453C	Gloucester - Canton complex, 8 to 15 percent slopes, extremely bouldery	A	14.5	5.7%
480B	Plymouth - Carver complex, 3 to 8 percent slopes	A	15.0	5.9%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
480C	Plymouth - Carver complex, 8 to 15 percent slopes	A	1.8	0.7%
608	Water, ocean		77.7	30.7%
610	Beaches, sand		4.6	1.8%
656B	Udorthents - Urban land complex, 0 to 8 percent slopes	B	5.8	2.3%
659B	Udorthents, 0 to 8 percent slopes, gravelly	B	6.1	2.4%
702C	Udipsamments, 8 to 15 percent slopes	A	4.6	1.8%
<b>Totals for Area of Interest</b>			<b>252.7</b>	<b>100.0%</b>

## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

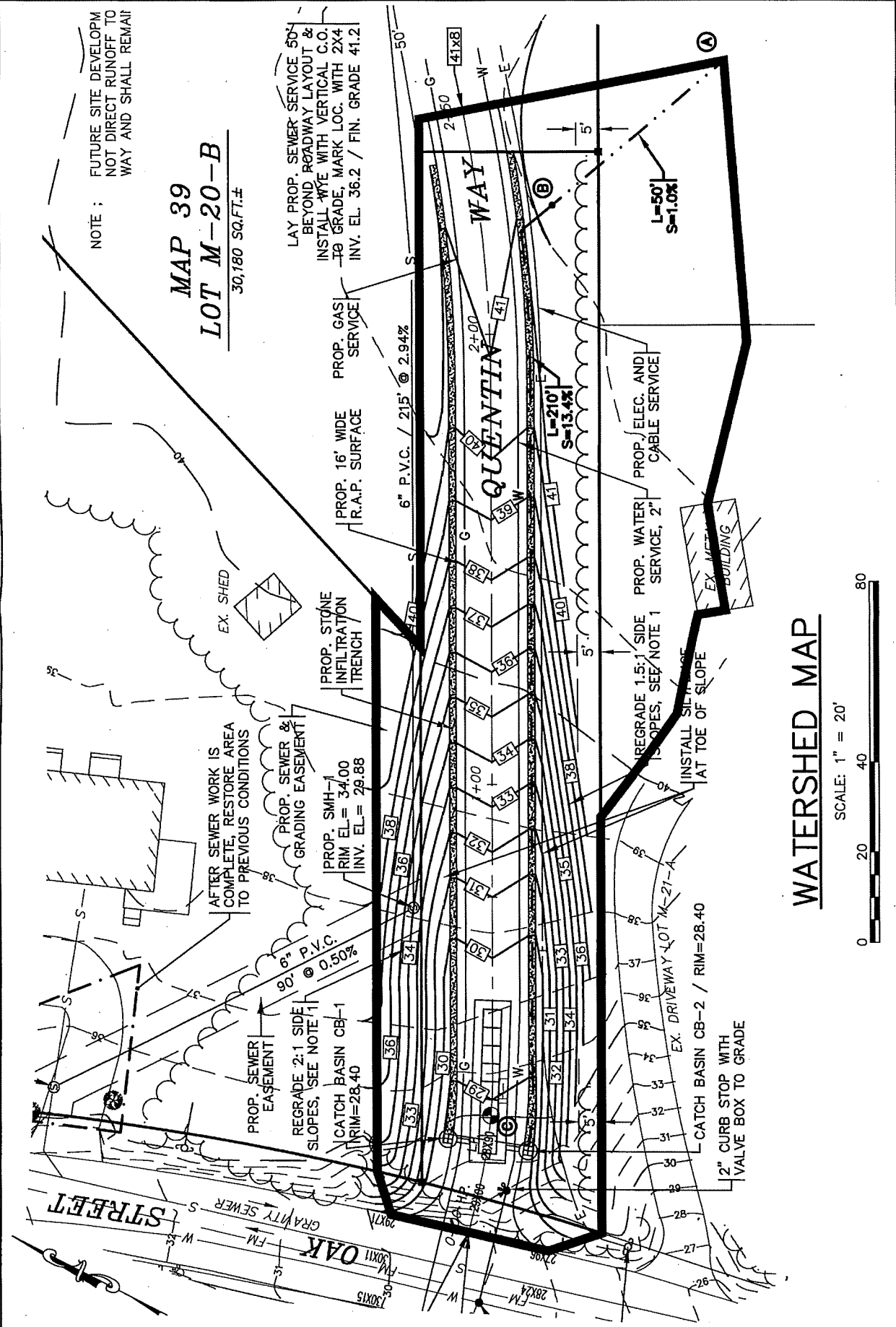
*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

<b>G.A.F. ENGINEERING, INC.</b> PROFESSIONAL ENGINEERS & LAND SURVEYORS 266 MAIN STREET - WARREN, MA 02571 TEL: (508) 295-6600 FAX: (508) 295-6634 E-MAIL: info@gafeng.com		PREPARED FOR: <b>DAVID M. MATHER</b> WARREN, MA	
DATE: DEC. 4, 2023 DRAWN BY: JMP CHECKED BY: RJR		JOB NO.: 18-2267 SCALE: 1" = 20' DESCRIPTION:	

DWG. 1 OF 1



**WATERSHED MAP**

SCALE: 1" = 20'



BY: JAF DRAWINGS 2018 TRAINING 10-2021 (AUTO) 1/25/21 (JAF) 1/25/21 (JAF) 1/25/21 (JAF)